

BIDIRECTIONAL PNEUMATIC IMPACT WRENCH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a pneumatic impact wrench, and more particularly to a bidirectional pneumatic impact wrench with a rotatable air control valve that has two spiral air grooves to direct compressed air to control the direction of rotation of a pneumatic motor in the bidirectional pneumatic impact wrench.

2. Description of Related Art

Pneumatic or air-driven impact wrenches are extensively used to rapidly fasten or loosen bolts or nuts. Most pneumatic impact wrenches generally have an air control valve to direct compressed air and control the direction of rotation of a drive shaft of the pneumatic impact wrench to fasten or loose bolts or nuts.

A rotatable air control valve is convenient to use because a person just needs to rotate the air control valve to change the direction of rotation of the drive shaft. A conventional air control valve in a bidirectional pneumatic impact wrench uses a cylindrical shaft with multiple air slots with different diameters. The air slots are equally spaced along the cylindrical shaft. When operating the air control valve, the air slot with a desired diameter selectively makes a desired air slot communicate with a pneumatic motor of the impact wrench. The airflow of the compressed air is directed and regulated by the desired air slot. However, this kind of air control valve cannot directly reverse the rotation of the pneumatic motor and needs a reversing device to make the rotation of the motor reverse. The conventional air control valve has a complicated structure and only makes

1 the pneumatic motor rotate in one direction, which raises manufacturing cost.

2 The conventional cylindrical shaft of the air control valve uses simply
3 air slots with different diameters, which cannot accurately direct and regulate the
4 airflow of the compressed air to make the pneumatic impact wrench output
5 optimum torque.

6 To overcome the shortcomings, the present invention provides an
7 improved air control valve cylindrical shaft to mitigate or obviate the
8 aforementioned problems.

9 SUMMARY OF THE INVENTION

10 The main objective of the invention is to provide a pneumatic impact
11 wrench that has a rotatable air control that has a simple structure and efficiently
12 directs compressed air to a desired path in the pneumatic impact wrench.

13 A pneumatic impact wrench in accordance with the present invention
14 includes a pneumatic motor and an air control valve. The pneumatic motor has a
15 forward air inlet and a reverse air inlet. The air control valve selectively directs
16 compressed air to either the forward air inlet or the reverse air inlet to change
17 direction of rotation of the pneumatic motor and includes a rotatable shaft. The
18 shaft has an exterior surface and a spiral forward air groove and reverse air
19 groove that are symmetrically defined in the exterior surface to direct the
20 compressed air efficiently. The air control valve has a simple structure and
21 directs the compressed air into the pneumatic motor efficiently to improve power
22 and efficiency of the pneumatic motor because of the spiral air grooves in the
23 shaft.

24 Other objectives, advantages and novel features of the invention will

1 become more apparent from the following detailed description when taken in
2 conjunction with the accompanying drawings.

3 BRIEF DESCRIPTION OF THE DRAWINGS

4 Fig. 1 is an exploded perspective view of a pneumatic impact wrench in
5 accordance with the present invention;

6 Fig. 2 is a partially exploded perspective view of the pneumatic impact
7 wrench in Fig. 1;

8 Fig. 3 is an enlarged exploded perspective view of a rear assembly and a
9 valve of the pneumatic impact wrench in Fig. 2;

10 Fig. 4 is a front plan view of a gasket attached to a rear cover of the rear
11 assembly in Fig. 3;

12 Fig. 5 is an operational rear plan view of the pneumatic impact wrench in
13 Fig. 1;

14 Fig. 6 is an operational side plan view in partial section of the pneumatic
15 impact wrench in Fig. 1 when the pneumatic motor is rotated in a reverse
16 direction;

17 Fig. 7 is an operational side plan view in partial section of the pneumatic
18 impact wrench when the pneumatic motor in Fig. 6 is stopped; and

19 Fig. 8 is an operational side plan view in partial section of the pneumatic
20 impact wrench when the pneumatic motor in Fig. 1 is rotated in a forward
21 direction.

22 DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

23 With reference to Fig. 1, a pneumatic impact wrench (not numbered) in
24 accordance with the present invention comprises a housing (10), a front

1 assembly (14), a hammer assembly (15), a pneumatic motor (16), a rear
2 assembly (20) and an air control valve (30).

3 With further reference to Fig. 6, the housing (10) comprises a motor
4 casing (11) and a handle (12). The motor casing (11) has a front (not numbered),
5 a rear (not numbered), a bottom (not numbered), a motor chamber (111), a
6 forward air passage (112), a reverse air passage (113), a valve chamber (114) and
7 a motor-air discharge port (not numbered). The motor chamber (111) is defined
8 longitudinally completely through the motor casing (11). The valve chamber
9 (114) is defined in the rear of the motor casing (11) under the motor chamber
10 (111). The forward and the reverse air passages (112, 113) are symmetrical and
11 are defined in the motor casing (11) at the rear on opposite sides of the valve
12 chamber (114) below the motor chamber (111). The forward air passage (112)
13 has an inlet (1121) and an outlet (not numbered). The outlet is defined in the rear
14 of the motor casing (111). The inlet (1121) opens to the valve chamber (114).
15 Likewise, the reverse air passage (113) has an inlet (1131) and an outlet (not
16 numbered). The outlet is defined in the rear of the motor casing (111). The inlet
17 (1131) opens to the valve chamber (114). The motor-air discharge port may be
18 implemented with two discharge channels (115). The motor chamber (111)
19 communicates with the valve chamber (114) through the discharge channels
20 (115).

21 The handle (12) integrally extends from the bottom of the motor casing
22 (11) and has a compressed air passage (121), an exhaust air passage (122) and an
23 air supply valve (123). The compressed air passage (121) and the exhaust air
24 passage (122) have respectively an inner opening (not numbered) and

1 communicate with the valve chamber (114) through the inner openings. The air
2 supply valve (123) is mounted in the compressed air passage (121) to control
3 compressed air to the valve chamber (114).

4 The front assembly (14) is attached to the front of the motor casing (11)
5 and comprises a front cover (141) and an anvil shaft (142). The front cover (141)
6 is attached to the front of the motor casing (11) to cover the motor chamber (111).
7 The anvil shaft (142) is mounted rotatably in the front cover (141).

8 The hammer assembly (15) is mounted in the motor chamber (111), and
9 connects to and drives the anvil shaft (142), and the hammer assembly (15) may
10 have a conventional structure and is not further described.

11 The pneumatic motor (16) is mounted in the motor chamber (111) and
12 connects to and drives the hammer assembly (15). The pneumatic motor (16) has
13 a rear (not numbered), a reverse air inlet (161), a forward air inlet (162) and an
14 air outlet (163). The forward air inlet (162) is defined in the rear to allow
15 compressed air to enter and rotate the pneumatic motor (16) in a forward
16 direction. Likewise, the reverse air inlet (161) is defined in the rear to allow
17 compressed air to enter and rotate the pneumatic motor (16) in a reverse
18 direction. The air outlet (163) may be two through holes. Therefore, the
19 compressed air will enter only either the forward air inlet (162) or the reverse air
20 inlet (162) and be discharged out of the pneumatic motor (16) through the air
21 outlet (163). Since the pneumatic motor (16) may have a conventional structure,
22 further detailed description is not provided.

23 With further reference to Figs. 2 and 4, the rear assembly (20) is attached
24 to the rear of the motor casing (111) by bolts (not numbered) and comprises a

1 rear cover (21) and a gasket (22). The rear cover (21) is attached to the rear of the
2 motor casing (11) to cover the motor chamber (111) and has an inner side (not
3 numbered), an outer side (not numbered), a reverse air passage (211), a forward
4 air passage (212) and a countersunk hole (213). The forward air passage (212)
5 and the reverse air passage (211) are defined symmetrically in the inner side of
6 the rear cover (21) and have respectively a curved upper segment (not numbered)
7 and a vertical lower segment (not numbered). The curved upper segment of the
8 forward air passage (212) is aligned and communicates with the forward air inlet
9 (162) in the pneumatic motor (16). The upper segment of the reverse air passage
10 (211) is aligned and communicates with the reverse air inlet (161) in the
11 pneumatic motor (16). The countersunk hole (213) is defined in the outer side of
12 the rear cover (21) and is aligned with the valve chamber (114) in the motor
13 casing (111). The countersunk hole (213) has a bottom (not numbered). The
14 bottom of the countersunk hole (213) has a control valve hole (214) and multiple
15 detents (215). The control valve hole (214) is defined through the bottom of the
16 countersunk hole (213), is aligned with the valve chamber (114) in the motor
17 casing (111) and communicates with the valve chamber (114). The detents (215)
18 are defined in the bottom and are arranged in a curved line above the control
19 valve hole (214). The gasket (22) is mounted between the rear of the motor
20 casing (111) and the rear cover (21) to form an airtight seal.

21 With further reference to Fig. 3, the air control valve (30) is mounted
22 rotatably at the outer side of the rear cover (21) and comprises a rotatable shaft
23 (31), a knob (32), a positioning device (not numbered) and three O-rings (35).
24 The shaft (31) is rotatable held in the control valve hole (214) and the valve

1 chamber (114) and has an inside end (not numbered), an outside end (not
2 numbered), an exterior surface (not numbered), a reverse air groove (311), a
3 forward air groove (312), an axial hole (313), a tangential slot (314) and three
4 annular slots (315).

5 The inside end of the shaft (31) is inserted into the control valve hole
6 (214) and extends into the valve chamber (114) so that the shaft (31) is held
7 rotatably in the valve chamber (114). The axial hole (313) is defined in the inside
8 end of the shaft (31). The annular slots (315) are defined around the exterior
9 surface with one adjacent to the inside end and the other two adjacent to the
10 outside end of the shaft (31). The forward and the reverse air grooves (312, 311)
11 are spiral and are defined symmetrically in the exterior surface between the
12 annular slots (315) to direct the compressed air from the compressed air passage
13 (121) to enter selectively into the inlet (1121) of the forward air passage (112) or
14 the inlet (1131) of the reverse air passage (113) in the motor housing (11). The
15 tangential slot (314) is defined in the exterior surface at a position that
16 corresponds to the inlet (1121) of the forward air passage (112) when the reverse
17 air groove (311) is aligned with the inlet (1131) of the reverse air passage (113)
18 and the inlet (1131) of the reverse air passage (113) when the forward air groove
19 (312) is aligned with the inlet (1121) of the forward air passage (112).

20 With reference to Figs. 1 and 7, the knob (32) is eccentrically attached to
21 the outer end of the shaft (31) and has an inner side (not numbered) and a spring
22 hole (321). The inner side of the knob (32) rotatably abuts the bottom of the
23 countersunk hole (213). The spring hole (321) is defined in an eccentric section
24 at the inner side of the knob (32) and selectively corresponds to the detents (215).

1 The positioning device is mounted between the bottom of the
2 countersunk hole (213) and the inner side of the knob (32) to hold the knob (32)
3 in place and comprises a ball (33) and a resilient element, such as a spring (34).
4 The spring (34) is mounted in the spring hole (321) of the knob (32). The ball (33)
5 is partially held in the spring hole (321), compresses the spring (34) in the spring
6 hole (321) and engages simultaneously one of the detents (215) to keep the knob
7 (32) from rotating.

8 The O-rings (35) are mounted respectively in the annular slots (315) on
9 the shaft (31). The O-ring (35) adjacent to the inner end of the shaft (31) is
10 positioned between the inner openings of the compressed air passage (121) and
11 the exhaust air passage (122) to keep the compressed air from directly being
12 exhausted through the exhaust air passage (122).

13 With reference to Figs. 3 and 5, a person can turn the knob (32) to rotate
14 the shaft (31) to change angular positions of the reverse air groove (311), the
15 forward air groove (312) and the tangential slot (314). Therefore, either the
16 reverse air groove (311) or the forward air groove (312) is used to direct the
17 compressed air into the pneumatic motor (16).

18 With reference to Figs. 3 and 6, the air supply valve (123) is open to
19 allow the compressed air to enter the valve chamber (114) through the inner
20 opening of the compressed air passage (121). The shaft (31) can be turned to
21 reverse the direction of the pneumatic motor (16). For instance, the reverse air
22 groove (311) communicates with the inner opening of the compressed air
23 passage (121) and the inlet (1131) of the reverse air passage (113). The incoming
24 compressed air is directed into the vertical lower segment of the reverse air

1 passage (211) in the rear cover (21) through the outlet of the reverse air passage
2 (113). The compressed air moves upward into the curved upper segment of the
3 reverse air passage (211), which redirects the compressed air into the pneumatic
4 motor through the reverse air inlet (161) to cause the pneumatic motor (16) to
5 reverse rotation. Most of the incoming compressed air in the pneumatic motor
6 (16) is vented through the air outlet (163) and into the motor chamber (111). The
7 compressed air in the motor chamber (111) enters the exhaust air passage (122)
8 through the discharge channels (115) and is eventually vented to the atmosphere.
9 A small amount of the compressed air in the pneumatic motor (16) enters the
10 curved upper segment of the forward air passage (212) in the rear cover (21)
11 through the forward air inlet (162). The compressed air in the forward air
12 passage (212) enters the axial hole (313) in the shaft (31) through the forward air
13 passage (112) and the tangential slot (314) that communicates with the inlet
14 (1121) of the forward air passage (112) in the motor housing (11). The
15 compressed air in the axial hole (313) enters the exhaust air passage (122)
16 through the valve chamber (114) insulated by the O-ring (35) adjacent to the
17 inner end of the shaft (31).

18 With reference to Figs. 5 and 7, the ball (33) engages a respective one of
19 the detents (215) to hold the shaft (31) after the knob (32) is released when a
20 person turns the knob (32) to change the direction of rotation of the pneumatic
21 motor (16). As the shaft (31) is turned, the angular positions of the forward and
22 the reverse air grooves (312, 311) are changed, and in one particular position,
23 they do not communicate with the forward and the reverse air passages (112,
24 113), which stops the compressed air from going to the pneumatic motor (16).

1 The pneumatic motor (16) is stopped.

2 With reference to Figs. 3, 5 and 8, continuously turning the knob (32)
3 causes the forward and the reverse air grooves (312, 311) and the tangential slot
4 (314) in the shaft (31) to change again, which makes the forward air groove (312)
5 communicate with the inner opening of the compressed air passage (121)
6 through the inlet (1121) of the forward air passage (112). Simultaneously, the
7 tangential slot (314) communicates with the inlet (1131) of the reverse air
8 passage (113) to the axial hole (313).

9 Consequently, the air control valve (30) has a simple structure that can
10 be simply fabricated and assembled to save manufacturing coats. The shaft (31)
11 of the air control valve (30) has a positioning device that uses a ball (33) and
12 spring (34) combination to precisely hold the knob (32) in place to keep the shaft
13 (31) from unexpectedly rotating. Therefore, the forward and the reverse air
14 grooves (312, 311) can precisely direct the compressed air into the forward and
15 the reverse air inlets (162, 161) to enhance the motor power and improve the
16 motor efficiency.

17 Even though numerous characteristics and advantages of the present
18 invention have been set forth in the foregoing description, together with details
19 of the structure and function of the invention, the disclosure is illustrative only,
20 and changes may be made in detail, especially in matters of shape, size, and
21 arrangement of parts within the scope of the appended claims.